CLAIMS

1. A polarization-independent optical isolator/circulator comprising a two-arm interferometer including nonreciprocal phase shifters in both interferometric arms, wherein a nonreciprocal phase shifter includes a half-wave retarder with its slow-axis at 45°, and two sets of transverse magnetic (TM) mode nonreciprocal phase shifters including vertically asymmetric magneto-optical waveguides with a transverse magnetic field across each arm, wherein magnetizations of magneto-optical materials in said arms are opposite to each other to create ±90° nonreciprocal phase shift for the TM mode, and said two sets of TM-mode nonreciprocal phase shifters have a half-wave retarder placed between them to rotate the polarization so that both orthogonal polarizations will have ±90° nonreciprocal phase shift, allowing the total phase difference between the two arms for forward and backward directions to be different by 180° for both orthogonal polarizations.

2. The isolator/circulator of claim 1 further comprising two input ports and one output port.

3. The isolator/circulator of claim 1 further comprising a 90° reciprocal phase shift in one arm of the interferometer so that the total phase difference is 0° for one propagation direction and 180° for the other propagation direction.

4. The isolator/circulator of claim 3 further comprising two input ports and two output ports.

5. The isolator/circulator of claim 3 further comprising one input port and one output port.

6. The isolator/circulator of claim 1, wherein the nonreciprocal phase shifter is replaced by a Faraday rotator and half-wave retarders for both arms, where the principal axis of one retarder has 45° offset from the other, and a Faraday rotator and a half-wave retarder are placed in the same order in both arms of the interferometer.

7. The isolator/circulator of claim 6, wherein the magnetizations of the Faraday rotators are opposite.

8. The isolator/circulator of claim 6, wherein each arm has a plurality of Faraday rotator crystals or waveguide devices, each being spatially separated from the others, and the total Faraday rotation of these devices has 45° nonreciprocal polarization rotation.

9. The isolator/circulator of claim 8, wherein the order of Faraday rotators and half-wave retarders are different between the two interferometric arms and the directions of magnetization of the Faraday rotators are the same.

10. The isolator/circulator of claim 6 further comprising a waveguide structure at the Faraday rotator and/or a half-wave retarder.

11. The isolator/circulator of claim 6 further comprising a thermally expanded core fiber at any input or output ports.

12. The isolator/circulator of claim 1 further comprising vertical and/or horizontal

adiabatic tapers at any optical interface.

13. The isolator/circulator of claim 6 further comprising at least one thin-film magnet adjacent to said one or more Faraday rotators.

14. The isolator/circulator of claim 6, wherein at least one of said thin-film Faraday rotators and/or thin-film half-wave retarders are inserted into grooves where these films see the optical beam axis of at least one optical path.

15. The isolator/circulator of claim 6, wherein at least one of the said half-wave retarders comprises stress-applying films.

16. The isolator/circulator of claim 6 further comprising collimating lenses.

17. The isolator/circulator of claim 6 further comprising at least one variable phase shifter and/or at least one variable attenuator, wherein phase and power compensation in the interferometer arms can be passive or active.

18. The isolator/circulator of claim 6 further comprising two input ports and two output ports.

19. The isolator/circulator of claim 6 further comprising two input ports and one output port.

20. The isolator of claim 6 further comprising one input port and one output port.

21. A polarization independent optical isolator/circulator based on a nonreciprocal

phase shifter comprising:

a plurality of Mach-Zehnder waveguide interferometers;

a plurality of half-wave retarders; and

one or more Faraday rotators with a total rotation of 45°.

22. The isolator/circulator of claim 21, wherein one path of each interferometer includes a half-wave retarder, wherein the slow axes of the retarders are either parallel or perpendicular to each other so that, with a proper phase and/or power compensation between the two paths by either active or passive means, a light that enters through one of the input ports is split in the first interferometer into two linearly polarized components and recombined into one of the output ports in the second interferometer.

23. The isolator/circulator of claim 21, wherein at least one of the two interferometers is replaced by an interferometer which has a quarter-wave retarder in each path and an additional 90° path length difference between the two paths, and the slow axes of the two quarter-wave retarders are perpendicular to each other.

24. The isolator/circulator of claim 21, with one or more Faraday rotators having a total Faraday rotation of 45° and a half-wave retarder with the slow axis at 22.5° relative to one of the slow axes of the retarders of claim 23 in between said interferometers, so that the angle of said linearly polarized light will not change in one propagation direction and will be rotated by 90° in the other propagation direction.